Amendments to the Specification:

Please add the following new paragraph at the beginning of page 1:

STATEMENT OF RELATED CASE

This application is related to United States Patent Application Serial No. 09/943,569 filed August 30, 2001 in the name of the same inventor and entitled "System and Method for Removing Deposited Material From Within A Semiconductor Fabrication Device".

Please replace the paragraph on page 1, line 2 with the following amended paragraph:

The present invention relates detecting occlusions in a semiconductor fabrication chamber assembly. In particular, the present invention relates to a system and method for detecting and reacting to occlusions, and for maintaining a cleaner semiconductor fabrication chamber.

Please replace the paragraph on page 1, line 8 with the following amended paragraph:

In the typical existing semiconductor fabrication chambers, the environment of the chamber produces a sheeting layer of material on the walls of the chamber, and in the inlets and outlets to such chambers. This is due to the reaction atmosphere inside the chamber. In the course of semiconductor fabrication operations, the sheeting approaches levels that restricts ~~restricts~~ or does ~~does~~ not allow at all for the passage of gas through the chamber vessel and related intakes and outlet ~~outtake~~ systems. When this occurs, the chamber must be opened and cleaned. This process is known as a "wet clean."

Please replace the paragraph on page 2, line 15 with the following amended paragraph:

Thus, the timing of the cleanings, when improperly timed, results in excessive downtime for the system. If a chamber is cleaned before the necessary time, then there is also a substantial loss ~~shortfall~~ in the potential fabrication time. ~~associated with this.~~

Please replace the paragraph on page 2, line 19 with the following amended paragraph:

Further, when there is some catastrophic failure, such as an early occlusion of the chamber or the piping, this could severely damage the manufacturing equipment ~~instruments~~. Additionally the materials being processed stand a great chance of being damaged in such a ~~this~~ failure. This problem dictates that a cleaning schedule be determined with a conservative estimate of time between cleanings. However, the conservative time between cleaning dictates a great deal of loss of potential fabrication time ~~downtime~~ for the system.

Please replace the paragraph on page 2, line 26 with the following amended paragraph:

Further, the time and effort to clean the chamber and process flow walls may be extensive. Further, at times the deposited material may not be sufficient to justify the cleaning process, since time and effort must also be spent in de-absorbing molecules from the wall of the chamber and process flow modules. The opening of the chamber to clean it introduces various environmental agents to the walls of the process flow modules and the reaction chamber. As such, a disadvantage with a full clean of the system is also found in the time to reseal the chamber and de-absorb molecules from the chamber and process flow module walls.

Please replace the paragraph on page 3, line 4 with the following amended paragraph:

In this manner, the typical prior art approach does not allow for flexible processing schedules as well as the early detection of occlusive events in such a system. Nor do the typical prior art systems allow for the active reduction of deposited residual materials on the walls of the chamber, or the associated process flow structures without opening the system to an external atmosphere. In this manner, the typical prior art cannot dynamically adapt and proactively attempt to reduce the occlusive effects of buildup in chamber walls. Many other problems and disadvantages of the prior art will become apparent to one skilled in the art after comparing such prior art with the present invention as described herein.

Please replace the paragraph on page 4, line 2 with the following amended paragraph:

Aspects of the invention are found in a system for occlusion ~~buildup~~ detection in a semiconductor manufacturing system. The semiconductor manufacturing ~~This~~ system produces integrated circuit structures on semiconductor wafers. The system has a chamber for placing the semiconductor wafers, and the chamber is environmentally coupled to a gas source through a gaseous flow path.

Please replace the paragraph on page 4, line 7 with the following amended paragraph:

The ~~detector~~ occlusion detection system is made of a flow detector, interposed in the gaseous flow path[[,]] that determines a flow rate of gas flowing from the gas supply to the rest of the manufacturing system. A flow comparator is coupled to the flow detector. The flow comparator compares the detected flow rate of the gas to a baseline flow rate of gas.

Please replace the paragraph on page 4, line 12 with the following amended paragraph:

In another aspect of the invention the flow detector is a heating element coupled to a power supply, and the heating element heats the gas flowing past it. In this manner, the volume or flow of gas can be determined through thermal measurement. A ~~temperature-measuring~~ temperature measuring device is coupled to the heating element, and the heating element can be selectively enabled in response to a signal from the ~~temperature-measuring~~ temperature measuring device.

Please replace the paragraph on page 4, line 21 with the following amended paragraph:

In another aspect of the invention the ~~detector~~ occlusion detection system has a flow controller. This flow controller is communicatively coupled to the gas supply and controls the flow of gas to the chamber in response to a signal from the flow detector. The invention may ~~contain a~~ include control circuitry communicatively coupled to the flow detector. The control circuitry is responsive to a predetermined value related to the rate of flow of the gas to the chamber. The control circuitry may be programmable. This may be used to issue an alarm in response to the detection of the predetermined value, or to update a maintenance schedule in response to the detection of a predetermined value. The control circuitry can change the operational status of the system in response to the detection of a predetermined value as well.

Please replace the title on page 6, line 1 with the following amended title and paragraph:

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more embodiments of the present invention and, together with the detailed description, serve to explain the principles and implementations of the invention.

In the drawings:

Please replace the paragraph on page 6, line 23 with the following amended paragraph:

Figure 8 is a flow diagram of a method that may be employed by the system of Figure 1 to alleviate ~~deposit~~ deposited material in the semiconductor manufacturing system.

Please replace the paragraph on page 6, line 26 with the following amended paragraph:

Figure 9 is a flow diagram of an alternative embodiment of the method of Figure 7.

Please replace the paragraph on page 7, line 3 with the following amended paragraph:

Figure 1 is a schematic block diagram of an occlusion detection system according to an embodiment of the invention. A semiconductor manufacturing system 10 contains a ~~semiconductor-manufacturing~~ semiconductor manufacturing reaction chamber 12. ~~The chamber~~ Chamber 12 contains semiconductor wafers that are processed, typically at near-vacuum pressures. The process may take place at various temperatures. Typically, the environment where the wafer is located while being processed can be at a high temperature to facilitate physical and chemical processes occurring to the wafer.

Please replace the paragraph on page 7, line 10 with the following amended paragraph:

The system 10 also contains a gas ~~source~~ supply 14 and a gas outlet 16, both coupled to ~~the~~ chamber 12. In this manner, gases may be cycled from the gas source 14 to the gas outlet 16 through the chamber 12.

Please replace the paragraph on page 7, line 13 with the following amended paragraph:

The flow of gas through the system is controlled by a flow controller. In this manner, the amount of gas flowing through ~~the reaction~~ chamber 12 may be closely controlled.

Please replace the paragraph on page 7, line 16 with the following amended paragraph:

A flow detection unit 19 monitors the flow of gas from ~~the~~ gas supply 14 to ~~the~~ chamber 12 and ~~the~~ associated downstream process flow modules. As such, a difference in the flow rates of the ~~fabrication~~ system 10 indicate an occlusion in the system. Typically, ~~the~~ flow testing will take place at pressures higher than those used for fabrication processes. The higher volumes and flow rates can indicate a problem sooner than ~~well in advance as opposed to~~ the lower pressures found during normal manufacturing ~~in the production systems~~. The occlusion detection system can be used in production type operations, but its effectiveness is increased with higher pressures than typically found in production.

Please replace the paragraph on page 8, line 6 with the following amended paragraph:

Figure 2 is an exemplary embodiment of a flow metering system as depicted in Figure 1. In this particular embodiment, the flow meter contains a heating element 20 interposed between ~~the~~ gas supply 14 and ~~the~~ chamber 12. ~~The heating~~ Heating element 20 can be used to heat the gas from gas supply 14 ~~supply~~ to provide an optimal temperature in ~~the reaction~~ chamber 12 for the semiconductor fabrication process.

Please replace the paragraph on page 8, line 11 with the following amended paragraph:

A temperature ~~measurement~~ measuring device 22 monitors the temperature of the gas flowing from ~~the~~ gas supply 14 to ~~the reaction~~ chamber 12 after it has been heated by ~~the~~ heating element 20. The temperature may be monitored by various means, including a thermocouple. In this manner, a heated gas may be swept through ~~the reaction~~ chamber 12. In a reaction process for semiconductor materials, the gas can be an inert gas, such as argon, or a reactive gas. In terms of the flow metering, any gas conducive to the internal environment of ~~the reaction~~ chamber 12 or other process flow module may be used.

Please replace the paragraph on page 8, line 19 with the following amended paragraph:

~~The heating~~ Heating element 20 is typically a ~~reactive~~ resistive-type heating element, requiring electric power to maintain a temperature. As such, ~~the~~ heating element 20 is coupled to a heating power controller 26. The heating power controller 26 maintains power to ~~the~~ heating element 20, thus allowing ~~the~~ heating element 20 to heat the gas flowing to ~~the reaction~~ chamber 12.

Please replace the paragraph on page 8, line 24 with the following amended paragraph:

A power measurement device 28 monitors the power flow in to the heating power controller 26. The power management device 28 measures the amount of heating that the heating element 20 performs on the gas flowing to ~~the reaction~~ chamber 12.

Please replace the paragraph on page 8, line 28 with the following amended paragraph:

Both the temperature ~~measurement~~ measuring device 22 and the power management device 28 are coupled to ~~coupled to a~~ control circuitry 24. ~~The control~~ Control circuitry 24 monitors the status of the temperature, the power used, or both. Thus, ~~the~~ control circuitry 24 can monitor the entire state of the gas flow, and the heating state of the semiconductor manufacturing system[[_]]10.

Please replace the paragraph on page 9, line 3 with the following amended paragraph:

~~The control~~ Control circuitry 24 is coupled to a flow controller 18, and/or ~~the~~ heating power controller 26. In this manner, the amount of gas flowing into the system and/or the temperature of the gas may be monitored and determined.

Please replace the paragraph on page 9, line 6 with the following amended paragraph:

In an exemplary embodiment, the semiconductor manufacturing system 10 is operating at a certain state. The gas is flowing at a determined rate and at a determined temperature to ~~the reaction~~ chamber 12. As the gas flows across ~~the~~ heating element 20, the gas is heated according to the amount of power released by ~~the~~ heating element 20. Should the temperature measuring

~~temperature-measuring~~ device 22 determine that the temperature is below a certain threshold, it may indicate this to ~~the~~ control circuitry 24. In turn, ~~the~~ control circuitry 24 ~~initiates~~ instructs the heating power controller 26 to adopt a longer duty cycle. The duty cycle of ~~the~~ heating power controller 26 is monitored by ~~the~~ power management device 28, and the results of this measurement are sent back to ~~the~~ control circuitry 24.

Please replace the paragraph on page 9, line 16 with the following amended paragraph:

The heat of the gas at ~~the~~ ~~temperature-measuring~~ temperature-measuring device 22 is proportional to the heat transferred to the gas by ~~the~~ heating power controller 26. The heat transferred to the gas by heating power controller 26 is related to the volume of gas flowing to ~~the reaction~~ chamber 12. Thus, the heat of the gas as determined by ~~the~~ temperature measuring device 22 is related to the volume of gas flowing to ~~the reaction~~ chamber 12.

Please replace the paragraph on page 9, line 22 with the following amended paragraph:

Further, the heat transferred to the gas is related to the duty cycle of ~~the~~ heating power controller 26. In this manner, the volume of gas flowing can be determined by the results from ~~of~~ the power management device 28.

Please replace the paragraph on page 9, line 25 with the following amended paragraph:

If an occlusion occurs, then the ability of the semiconductor manufacturing system 10 to vent gas from the ~~outtake~~ outlet 16 is diminished. This means that the volume of heated gas flowing through the system 10 is diminished, and that the amount of heat that must be added to

the system is also diminished. When the duty cycle of the heater is correspondingly diminished, this indicates a buildup of substance somewhere in the semiconductor manufacturing system 10.

Please replace the paragraph on page 10, line 1 with the following amended paragraph:

~~The control~~ Control circuitry 24 monitors the duty cycle of ~~the~~ heating power controller 26 through ~~the~~ power management device 28. The duty cycle is indicative of the buildup of ~~substance~~ materials in the system. When the duty cycle decreases, this is indicative of more buildup of material than before.

Please replace the paragraph on page 10, line 5 with the following amended paragraph:

~~The control~~ Control circuitry 24 not only monitors the duty cycle, but also monitors the rate at which the duty cycle changes. Thus, ~~the~~ control circuitry 24 can predict when a system will be ready for maintenance based on the direct measurement of power used by ~~the~~ heating power controller 26. Alternatively, when the rate of change varies abruptly, ~~the~~ control circuitry 24 may issue several types of warnings and actions, including shutting the system down. In the case when the flows are monitored during production, this would tend to avoid a catastrophic failure as ~~featured~~ described above.

Please replace the paragraph on page 10, line 13 with the following amended paragraph:

However, the occlusion detection system in accordance with an embodiment of the present invention is preferably used in an environment with higher than production-type pressures, and as such, a warning to clean the system prior to next use may be preferable. In this

case, a shutout mechanism may be employed with the ~~fabrication~~ manufacturing system 10. When a predetermined criteria is met, or a sudden change occurs, the occlusion detection system may generate an electronic shut out. This would disable operations in the particular semiconductor manufacturing system 10 until acceptable levels are reached.

Please replace the paragraph on page 10, line 20 with the following amended paragraph:

Alternatively, ~~the~~ control circuitry 24 may change the output of the gas through interacting with ~~the~~ flow controller 18 in an attempt to salvage the process in place. Thus, the occlusion detection system can interactively alter the process flow to facilitate both completion of the existing process without damage to the system or the resulting semiconductor ~~device~~ devices being fabricated.

Please replace the paragraph on page 10 line 25 with the following amended paragraph:

~~The~~ This exemplary embodiment ~~contains~~ offers many advantages. First, in many ~~semiconductor-manufacturing~~ semiconductor manufacturing systems, it is necessary to heat the gas flow. Thus, existing ~~reactive~~ heaters may be retrofitted to perform this measurement task. Secondly, the addition of the heating element to new systems is not an added burden to the existing parameters necessary for the system to work. Thirdly, abrupt changes may be detected and acted upon far in advance of a situation that would cause severe problems to the manufactured semiconductor devices or the system itself.

Please replace the paragraph on page 11, line 3 with the following amended paragraph:

In one embodiment, a similar or different flow detection device may be coupled at another part of the semiconductor manufacturing system[[_]]10. By comparing flow rates or pressures, specific locations of occlusions or types of occlusions may be identified.

Please replace the paragraph on page 11 line 7 with the following amended paragraph:

It should be noted that ~~the~~ power measurement device 28 might be directly coupled to ~~the~~ heating power controller 26 or ~~the~~ flow controller 18 for purposes of this discussion. Additionally, it should be noted that ~~the~~ temperature ~~monitor~~ measuring device 22 might be similarly coupled to ~~the~~ heating power controller 26 and/or ~~the~~ flow controller 18 as well. In this case, ~~the~~ power measurement device 28 or the temperature ~~measurement~~ measuring device 22 can directly control ~~the~~ heating power controller 26 and/or ~~the~~ flow controller 18 based on the state of the measurement(s).

Please replace the paragraph on page 11, line 15 with the following amended paragraph:

It should also be noted that the temperature ~~measurement~~ measuring device 22 need not be in direct line with ~~the~~ heating element 20. In fact, such a temperature ~~measurement~~ measuring device 22 may be placed anywhere downstream from the heating element 20.

Please replace the paragraph on page 12, line 6 with the following amended paragraph:

In ~~the~~ an application of the invention, an industrial gas heater voltage usually remains constant, such as 120 volts alternating current (VAC), 208VAC, or 240VAC as is supplied from

a power source. Since these voltages are very consistent, another way to control the element temperature can be provided. In one embodiment, the system controls the duty cycle of the element in the "On," or heating, state. This controls the amount of energy being delivered to ~~the resistance~~ heating element 20. This energy management procedure can very precisely control the heat output from ~~the~~ element 20. In the present system, the user calibrates the various duty cycles against different known gas flow volumes. With this calibration, the amount of gas being heated in ~~our~~ the system 10 may be determined, and thus the system can report this volume as needed.

Please replace the paragraph on page 12, line 17 with the following amended paragraph:

With the use of ~~our use of~~ heated gas flowing at greater volumes than that of production process gas flows, one is able to detect the growing restriction well in advance of ~~their~~ it becoming a problem. First, a baseline is established on a known system 10 that has been cleaned or purged, or otherwise known to be free of such restrictions. A high flow gas from the gas heating system is periodically blown through the ~~process~~ chamber 12 and through the vacuum system, and one can compare the relative gas flows. Any reduction in gas flow due to degradation in the pumping system efficiency can be detected and reported. This condition can be detected much earlier using the high flow gas condition. As such, required maintenance can be scheduled in order to minimize the impact on production.

Please replace the paragraph on page 12, line 28 with the following amended paragraph:

Figure 3 is a schematic block diagram of an implementation of the system of Figure 1 across multiple semiconductor manufacturing systems 10. In this diagram, the control circuitry or computing device monitors and affects multiple semiconductors manufacturing systems. Thus, a centralized process server may be realized. In this manner, the control circuitry or computing device can determine maintenance schedules for multiple semiconductor manufacturing systems concurrently. Additionally, the control circuitry or computing device may affect an alert system for the multiple semiconductor manufacturing systems.

Please replace the paragraph on page 13, line 5 with the following amended paragraph:

Figure 4 is a flow diagram detailing an exemplary process by which the semiconductor manufacturing system 10 of Figures 1 or 2 may operate. In this case, the occlusion detection system is programmed to respond to differing events in differing manners. These differing events are gleaned from the flow information, such as amount of occlusion, rate of buildup of occlusion, or change in the rate of buildup. Differing alarm levels may be defined for differing events or indicia. In response, events can be defined for the differing indicia, based upon the type or seriousness of the event.

Please replace the paragraph on page 13, line 13 with the following amended paragraph:

Figure 5 is a flow diagram detailing an exemplary process by which the semiconductor manufacturing system 10 of Figure 3 may operate. In a block 30, a baseline is determined for the semiconductor manufacturing system 10. In a block 32, the monitoring system monitors gas

flow characteristics in the semiconductor manufacturing system. The characteristics may include the gas flow level, the rate of change ("velocity") of the gas flow level, or the rate of change of the rate of change ("acceleration") of the gas flow level. Based on the levels of these characteristics, various levels of alerts or automatic functional steps can be defined.

Please replace the paragraph on page 13, line 22 with the following amended paragraph:

In this embodiment, when a monitor alarm level 1 occurs, depicted in a block 34, a specific alert is displayed. Of course, this alert may also be in the form of an electronic communication to an individual, perhaps by such means as an instant messaging service or e-mail. Alternatively, the electronic message may be sent to a database with the characteristics, which ~~mat~~ may tie into a separate maintenance scheduler.

Please replace the paragraph on page 13, line 28 with the following amended paragraph:

When the characteristics initiate an alarm level 2, as depicted in a block 36, the occlusion detection system may simply alter the flow/temperature characteristics to accommodate other parameters. These parameters may include time to finish a process, expected time to maximum occlusion, time to maintenance, or altering the thermal characteristics to effectuate a change in the system itself, as will be explained in a later section.

Please replace the paragraph on page 14, line 3 with the following amended paragraph:

When the characteristics initiate an alarm level 3, as depicted in a block 38, the occlusion detection system may shut the system 10 down. This would occur when the safety of the system

10 is implicated, or when the processes may no longer be effectuated absent some corrective action.

Please replace the paragraph on page 14, line 7 with the following amended paragraph:

Figure 6 is a flow diagram showing an exemplary method by which the occlusion detection systems of Figures 1, 2, or 3 may be operated. In a block 40, the occlusion detection system monitors the state of the system 10 through the gas flow. In a block 42, the rate of buildup or the present amount of buildup is calculated based on the flow parameters or the rate of change of the flow parameters.

Please replace the paragraph on page 15, line 1 with the following amended paragraph:

In an aspect of the invention, the deposit material is heated by the gas. Between production cycles, a high volume cycle may take place as described above, where larger volumes of heated gas are made to flow through the process flow. The heat contained in the gas places the environmental conditions in the reaction flow to a point that sublimation, or the process where solids transform directly to gas, may occur. As such, the molecules of the ~~deposited~~ deposited material sublimate into the flow stream and are carried out of the process cycle. Thus, the gas flow provides both the thermal energy for the sublimation, and the kinetic energy to carry the sublimated material out of the chamber. Thus, the intrinsic measurement mechanism may be used as an alleviation mechanism as well. In this case, any gas can be used, as described above. In cases where the reaction chemistries can tolerate a reactive gas, a reactive gas can be used to enhance the sublimation process.

Please replace the paragraph on page 15, line 14 with the following amended paragraph:

An alleviation cycle can be maintained, as described above in relation to the occlusion detection. The cycle can be driven by temporal schedules, usage schedules, or can be driven by the above-described flow rate determination. When the alleviation process is used, this tends to lengthen the time between wet cleans dramatically.

Please replace the paragraph on page 15, line 22 with the following amended paragraph:

It should be noted that these conditions might exist in production cycles as well. Thus, the system may actually self-clean through sublimation while measuring the problems. In one embodiment, a first run may determine the amount of deposit in the process flow. Then, based on the amount of deposit, the rate of change of deposit, or on the change in the rate of change of deposit, the thermal, temporal, or volumetric properties of the heating/flow gas mechanism may be altered to "clean up" certain amounts of ~~deposited~~ deposited material prior to the next production cycle. In this manner, the ~~deposited~~ deposited material in process flow may be alleviated without cracking the system open to an external environment.

Please replace the paragraph on page 16, line 1 with the following amended paragraph:

Figure 8 is a flow diagram illustrating a method that may be employed by the occlusion detection system of Figure 1 to alleviate ~~deposited~~ deposited material in the semiconductor manufacturing system 10. In a block 54, a preliminary gas flow measurement is taken. In a block 56, the occlusion detection system determines the parameters of the ~~deposited~~ deposited material. This includes the amount of ~~deposited~~ deposited material, the rate at which the

~~deposited~~ deposited material is building up, and the change of the rate at which the deposited material is building up. Based on these parameters, the thermal and flow characteristics of a closed seal maintenance cycle are chosen in a block 58, such that portions of deposited material will be sublimated out of the process flow. The process may repeat itself, or it may end as desired.

Please replace the paragraph on page 16 line 11 with the following amended paragraph:

Figure 9 is a flow diagram illustrating an alternative embodiment of the method of Figure 8. A sublimation process is initiated. The initial thermal/flow characteristics are set in a block 62. The process is monitored in a block 64. Based upon the measured parameters in a block 64, the thermal characteristics may be dynamically altered in the process in a block 66. Upon achieving a certain predetermined setting in a block 68, the process may self-end.

Please replace the paragraph on page 16, line 17 with the following amended paragraph:

It should be noted that the processes described above take place after the maintenance cycle that introduces an external environment into the inner structures of the process flow modules and ~~the reaction~~ chamber 12, and after these structures have had a ~~deadsorption~~ de-adsorption process run on them. This saves time and energy, since external molecules that may absorb into the chamber and process flow structures are not introduced into the system 10. This saves time and energy in repeated maintenance cycles exposed to the external environment and in time and effort for the resulting ~~deadsorption~~ de-adsorption process necessary after the process flow modules are resealed from the external environment. In this manner, the process may be

run repeatedly before a cleaning or maintenance operation that opens it to the external environment is necessary.

Please replace the paragraph on page 17, line 5 with the following amended paragraph:

In view of the ~~above identified~~ above-identified description of the present invention and associated drawings, other modifications and variations will now become apparent to those skilled in the art. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention as set forth in the claims which follow.